

## Claims

We claim:

- 1           1. A method for performing optical signal and beam distribution in a heterodyne  
2 interferometer, the method comprising:  
3           providing a planar lightwave circuit comprising a plurality of waveguide optical  
4 transmission elements and an input coupler and an output coupler arranged along the optical  
5 transmission elements;  
6           matching optical pathlengths of the transmission elements between the input coupler and  
7 the output coupler to compensate for thermal effects; and  
8           determining reference and measurement optical phases employing the input coupler and  
9 the output coupler.
- 1           2. The method according to claim 1, wherein the input coupler and the output coupler  
2 comprise optical waveguide directional couplers.
- 1           3. The method according to claim 1, wherein the input coupler and the output coupler  
2 comprise multimode interference (MMI) devices.
- 1           4. The method according to claim 1, wherein the input couplers comprise waveguide Y-  
2 branch couplers.

1 5. The method according to claim 1, wherein the output coupler comprises a waveguide  
2 directional coupler with a 50:50 splitting ratio.

1 6. The method according to claim 1, wherein the output directional couplers are operable  
2 to provide a differential output appropriate for balanced detection.

1 7. The method according to claim 1, wherein the output couplers comprise a 2x2  
2 multimode interference device operable to provide a differential output appropriate for balanced  
3 detection.

1 8. The method according to claim 1, wherein the output coupler comprises a 2x1  
2 combiner operable to provide a single ended output.

1 9. The method according to claim 1, further comprising:  
2 utilizing at least one of the input coupler and the output coupler to split off a reference  
3 phase signal; and  
4 selecting a coupling ratio for at least one of the input coupler and the output coupler to  
5 optimize a detected heterodyne output signal when unequal losses are encountered in either  
6 measurement optical paths or reference optical paths.

1 10. The method according to claim 1, further comprising:  
2 fabricating the planar lightwave circuit in silica on silicon.

1 11. The method according to claim 10, further comprising:  
2 fabricating the planar lightwave circuit in silica on silicon utilizing planar lightwave  
3 fabrication processes.

1 12. The method according to claim 1, further comprising:  
2 fabricating the planar lightwave circuit in silica on quartz.

1 13. The method according to claim 1, further comprising:  
2 fabricating the planar lightwave circuit from at least one of a polymer, a III-V  
3 semiconductor, silicon, and lithium niobate.

1 14. The method according to claim 1, further comprising:  
2 achieving dimensional control of waveguide and device critical dimensions of the planar  
3 lightwave circuit utilizing microelectronic photolithographic techniques to provide the planar  
4 lightwave circuit.

1 15. The method according to claim 1, further comprising:  
2 achieving dimensional control of matched planar lightwave circuit waveguide lengths  
3 utilizing microelectronic photolithographic techniques.

1 16. The method according to claim 1, further comprising:  
2 designing crossings of the transmission elements for application specific required  
3 minimal crosstalk.

1 17. The method according to claim 1, further comprising:  
2 fabricating selected mode polarization strippers at an input port and an output port of the  
3 planar lightwave circuit.

1 18. The method according to claim 17, further comprising:  
2 positioning a metal layer above or below the planar lightwave circuit; and  
3 inducing optical evanescent H-field currents in the metal to selectively strip a TM  
4 polarization mode off at the input and output ports.

1 19. A device operable to distribute optical signals and beams in a heterodyne  
2 interferometer, the device comprising:  
3 a planar lightwave circuit comprising a plurality of waveguide optical transmission  
4 elements; and  
5 an input coupler and an output coupler arranged along the optical transmission elements  
6 and operable to determine reference and measurement optical phases, wherein optical  
7 pathlengths of the optical transmission elements between the input coupler and the output  
8 coupler are matched to compensate for thermal effects.

1 20. The device according to claim 19, wherein the couplers comprise optical waveguide  
2 directional couplers.

1 21. The device according to claim 19, wherein the couplers comprise multimode

2 interference devices.

1 22. The device according to claim 19, wherein the couplers comprise waveguide Y-  
2 branch couplers.

1 23. The device according to claim 19, wherein the output coupler comprises a waveguide  
2 directional coupler having a 50:50 splitting ratio.

1 24. The device according to claim 23, wherein the output coupler is operable to provide a  
2 differential output appropriate for balanced detection.

1 25. The device according to claim 20, wherein the output coupler is operable to provide a  
2 differential output appropriate for balanced detection.

1 26. The device according to claim 19, wherein the output coupler comprises a 2x2 multi-  
2 mode interference device operable to provide a differential output for balanced detection.

1 27. The device according to claim 19, wherein the output coupler comprises a 2x1  
2 combiner operable to provide a single ended output.

1 29. The device according to claim 19, wherein at least one of the input coupler and the  
2 output coupler is operable to split off a reference phase signal.

1 30. The device according to claim 19, wherein at least one of the input coupler has a  
2 coupling ratio operable to optimize a detected heterodyne output signal when encountering  
3 unequal losses in measuring optical paths or reference optical paths.

1 31. The device according to claim 19, wherein the optical transmission elements are  
2 embedded in a silica layer.

1 32. The device according to claim 19, wherein the substrate is silicon.

1 33. The device according to claim 19, wherein the substrate is quartz.

1 34. The device according to claim 19, wherein the planar lightwave circuit comprises at  
2 least one of a polymer, a III-V semiconductor, silicon and lithium niobate.

1 35. The device according to claim 19, wherein the planar lightwave circuit further  
2 comprises:  
3 crossings of the waveguide optical transmission elements, the waveguide crossings being  
4 operable for application specific required minimal crosstalk.

5  
6 36. The device according to claim 19, further comprising:  
7 selected mode polarization strippers arranged at an input port and an output port of the  
8 planar lightwave circuit.

1           37. The device according to claim 36, wherein the TM polarization mode is selectively  
2   stripped off at the input and output ports by the use of optical evanescent H-field induced  
3   currents in an appropriately positioned metal above or below the optical waveguide.